

# MATHEMATICS, B.S.

Our department offers a Bachelor of Science (B.S.) degree in mathematics. Areas of emphasis within the major include general mathematics, actuarial science, secondary education and applied mathematics. The program provides students with foundational abilities in linear and abstract algebra as well as proficiency in logic, set theory, functions and fundamental methods of mathematical proof. In addition to core requirements, the department offers electives on topics such as applied math, geometry and topology, real analysis, discrete math, logic and number theory, to name only a few.

Mathematics is an ideal major or double major to build computational and collaborative skills for future researchers, scientists, economists and medical practitioners. Those immediately entering the workforce will have widely sought-after skills and habits of mind conducive to productive and rewarding careers. Students pursuing graduate-level studies will be prepared with the necessary analytical skills and effective problem-solving strategies.

Undergraduates may also pursue a B.S. with Distinction, which requires maintaining a high GPA, additional coursework, research experience and the completion of an undergraduate thesis with the mark of "distinction."

## Learning Outcomes

1. Graduates with a B.S. in Mathematics will demonstrate understanding of logic, set theory, functions, and fundamental methods of mathematical proof.
2. Graduates with a B.S. in Mathematics will demonstrate mastery of the fundamental theoretical concepts of linear algebra.
3. Graduates with a B.S. in Mathematics will be able to solve problems in linear algebra using standard computational algorithms.
4. Graduates with a B.S. in Mathematics will demonstrate mastery of the fundamental concepts and methods of proof in abstract algebra.
5. Graduates with a B.S. in Mathematics will demonstrate mastery of the fundamental concepts and methods of proof in real analysis.
6. Graduates with a B.S. in Mathematics will, if they wish to pursue studies at the graduate level, be prepared with the necessary analytical skills, openness to new ideas, and positive attitudes (patience, persistence, and enthusiasm) for success. Those going on to employment will have the analytical skills that they need, an ability to learn new ones, and habits of mind that are conducive to productive and rewarding work. Graduates will be aware that mathematics is often a collaborative activity, and that careful reading and clear writing are as important as computational skills. They will know that mathematics is continually growing as research answers old questions and brings forth new ones. Finally, they will find joy in learning, doing, and communicating mathematics to others.

## Transfer Requirement

In addition to the minimum University and College of Arts and Sciences requirements, a student seeking to transfer to the mathematics major from another program within the University, or from another accredited college or university, is required to have earned a grade of "B" or higher in at least one of the following courses, or their UofSC equivalent:

Course	Title	Credits
MATH 141	Calculus I	4
MATH 142	Calculus II	4

MATH 241	Vector Calculus	3
MATH 300	Transition to Advanced Mathematics	3

## Retention and Other Details

- A grade of C or better is required in each MATH course.
- A student may enroll in each MATH course a maximum of two times. (Enrolled in a course is interpreted to mean that a grade, including W or WF, has been recorded.)
- A student may repeat a maximum of three MATH courses. (Receiving a grade of W is not to be considered a repeat.)

## Admissions

### Entrance Requirements

New freshmen who meet University admissions standards are eligible for admission to degree programs offered by the college. A student who wishes to enter the College of Arts and Sciences from another college on the Columbia campus must be in good standing and have a cumulative GPA of 2.00 or higher. A student who wishes to enter the College of Arts and Sciences from another USC campus must fulfill one of the following requirements:

1. Be in good standing, meet the admission requirements for a baccalaureate degree on the Columbia campus, and have a cumulative GPA of 2.00 or higher.
2. Be in good standing and have completed 30 semester hours with a GPA of 2.00 or higher on a USC campus.

Some programs in the College of Arts and Sciences have special admission requirements established by the department or committee that supervises the specific degree program, for example, Cardiovascular Technology, Biological Sciences, Chemistry, Biochemistry and Molecular Biology, Economics, Environmental Science, the Bachelor of Arts in Interdisciplinary Studies, and the Bachelor of Science in Interdisciplinary Studies. These requirements are listed in the sections of this bulletin that describe department and special degree programs.

## Degree Requirements (120 hours)

### Program of Study

Requirements	Credit Hours
1. Carolina Core	34-46
2. College Requirements	15-19
3. Program Requirements	31-47
4. Major Requirements	24

### Founding Documents Requirement

All undergraduate students must take a 3-credit course or its equivalent with a passing grade in the subject areas of History, Political Science, or African American Studies that covers the founding documents including the United State Constitution, the Declaration of Independence, the Emancipation Proclamation and one or more documents that are foundational to the African American Freedom struggle, and a minimum of five essays from the Federalist papers. This course may count as a requirement in any part of the program of study including the Carolina Core, the major, minor or cognate, or as a general elective. Courses that meet this requirement are listed here (<https://academicbulletins.sc.edu/undergraduate/founding-document-courses/>).

## 1. Carolina Core Requirements (34-46 hours)

### CMW – Effective, Engaged, and Persuasive Communication: Written (6 hours)

*must be passed with a grade of C or higher*

- any CC-CMW courses (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

### ARP – Analytical Reasoning and Problem Solving (6-8 hours)

*must be passed with a grade of C or higher*

- MATH 141\*
- MATH 142\*

### SCI – Scientific Literacy (8 hours)

- Two 4-credit hour CC-SCI courses (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

### GFL – Global Citizenship and Multicultural Understanding: Foreign Language (0-6 hours)

Demonstration of proficiency in one foreign language equivalent to the minimal passing grade on the exit examination in the 122 course is required for all baccalaureate degrees. Students can demonstrate this proficiency by successfully completing Phase II of the Proficiency Test or by successfully completing the 122 course, including the exit exam administered as part of that course.

- CC-GFL courses (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

*It is strongly recommended that students continuing the study of a foreign language begin college-level study of that language in their first semester and continue in that language until their particular foreign language requirement is completed.*

### GHS – Global Citizenship and Multicultural Understanding: Historical Thinking (3 hours)

- any CC-GHS course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

### GSS – Global Citizenship and Multicultural Understanding: Social Sciences (3 hours)

- any CC-GSS course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

### AIU – Aesthetic and Interpretive Understanding (3 hours)

- any CC-AIU course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

### CMS – Effective, Engaged, and Persuasive Communication: Spoken Component<sup>1</sup> (0-3 hours)

- any overlay or stand-alone CC-CMS course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

### INF – Information Literacy<sup>1</sup> (0-3 hours)

- any overlay or stand-alone CC-INF course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

### VSR – Values, Ethics, and Social Responsibility<sup>1</sup> (0-3 hours)

- any overlay or stand-alone CC-VSR course (<https://academicbulletins.sc.edu/undergraduate/carolina-core-courses/>)

<sup>1</sup> **Carolina Core Stand Alone or Overlay Eligible Requirements** – Overlay-approved courses offer students the option of meeting two Carolina Core components in a single course. A maximum of two overlays is allowed. The total Carolina Core credit hours must add up to a minimum of 31 hours. Some programs may have a higher number of minimum Carolina Core hours due to specified requirements.

## 2. College Requirements (15-19 hours)

### Foreign Language (0-3 hours)

- only if needed to meet 122-level proficiency

### Analytical Reasoning (6-7 hours)

*Must be passed with a grade of C or higher*

Course	Title	Credits
CSCE 145	Algorithmic Design I (*)	4
or CSCE 106	Scientific Applications Programming	
Select one of the following:		3
STAT 509	Statistics for Engineers (*)	
STAT 512	Mathematical Statistics (*)	
STAT 515	Statistical Methods I (*)	
<b>Total Credit Hours</b>		<b>7</b>

### History (3 hours)

The College of Arts and Sciences requires one additional GHS course beyond the Carolina Core GHS requirement.

- If the Carolina Core GHS requirement is fulfilled by a **U.S. history** course, the College of Arts and Sciences history requirement must be fulfilled by a **non-U.S. history** course.
- If the Carolina Core GHS requirement is fulfilled by a **non-U.S. history** course, the College of Arts and Sciences history requirement must be fulfilled by a **U.S. history** course.

Please select the College of Arts and Sciences history requirement from the approved list of U.S. and non-U.S. history courses (<https://academicbulletins.sc.edu/undergraduate/arts-sciences/history-requirement/>).

### Social Science and Fine Arts or Humanities (6 hours)

- Social Science (3 hours)**
  - The College of Arts and Science requires one 3- hour Social Science Course (<https://academicbulletins.sc.edu/undergraduate/arts-sciences/courses-acceptable-social-science/>)
- Fine Arts/Humanities (3 Hours)**
  - A Bachelor of Science from the College of Arts and Sciences requires one 3-hour Fine Arts/Humanities Course (<https://academicbulletins.sc.edu/undergraduate/arts-sciences/courses-acceptable-social-science/>)

[academicbulletins.sc.edu/undergraduate/arts-sciences/courses-acceptable-fine-arts-humanities/](https://academicbulletins.sc.edu/undergraduate/arts-sciences/courses-acceptable-fine-arts-humanities/))

### 3. Program Requirements (31-47 hours)

#### Supporting Courses (6 hours)

*Must be passed with a grade of C or higher.*

Course	Title	Credits
MATH 241	Vector Calculus (*)	3
MATH 300	Transition to Advanced Mathematics (*)	3
<b>Total Credit Hours</b>		<b>6</b>

#### Cognate or Minor (12-18 hours)

Students must complete a cognate (12 hours) or a minor as part of this program. In lieu of a cognate or minor, an additional major may be added to a student's program of study. **Additional majors must include all major courses as well as any prescribed courses noted (\*) in the bulletin.**

Prescribed courses noted in the bulletin may be shared with Carolina Core, College requirements, and Program requirements in the primary program.

#### Cognate (12 hours)

The cognate must consist of twelve (12) hours of courses at the advanced level, outside of but related to the major. The cognate may be taken in one or more departments or programs.

Courses offered by departments and programs that are acceptable for cognate credit are outlined in the section titled Courses Acceptable for Cognate Credit in Degree Programs in the College of Arts and Sciences (<https://academicbulletins.sc.edu/undergraduate/arts-sciences/courses-acceptable-cognate/>). Some major programs have specific cognate requirements. It should be emphasized that the cognate is not a second set of elective courses to be chosen at random by the student. Students are urged to consult their major advisors for specific requirements in their major.

Unless otherwise noted, for Bachelor of Science degrees, cognate courses passed with a grade of D or higher are acceptable.

#### Minor (18 hours)

In place of the cognate a student in the College of Arts and Sciences may choose a minor consisting of at least 18 credit hours of prescribed courses.

The minor is intended to develop a coherent basic preparation in a second area of study. It differs from the cognate inasmuch as the courses must follow a structured sequence.

Courses applied toward general education requirements cannot be counted toward the minor. No course may satisfy both major and minor requirements. **All minor courses must be passed with a grade of C or higher.** At least half of the courses in the minor must be completed in residence at the University.

A list of minor programs of study can be found at Programs A-Z (<https://academicbulletins.sc.edu/undergraduate/programs-az/>).

#### Electives (7-29 hours)

120 (or 128) degree applicable credits are required to complete any degree at USC. After the cognate, minor or second major is complete, any additional credits needed to reach 120 (or 128) total credits can

be fulfilled by electives. No courses of a remedial, developmental, skill-acquiring, or vocational nature may apply as credit toward degrees in the College of Arts and Sciences. The College of Arts and Sciences allows the use of the Pass-Fail option on elective courses. Further clarification on inapplicable courses can be obtained from the College of Arts and Sciences.

### 4. Major Requirements (24 hours)

*A minimum grade of C is required in all major courses.*

#### Major Courses (9 hours)

Course	Title	Credits
MATH 544	Linear Algebra	3
MATH 546	Algebraic Structures I	3
MATH 554	Analysis I	3
<b>Total Credit Hours</b>		<b>9</b>

#### Major Electives (15 hours)

At least **one** course from the following:

Course	Title	Credits
MATH 511	Probability	3
MATH 520	Ordinary Differential Equations	3
MATH 534	Elements of General Topology	3
MATH 550	Vector Analysis	3
MATH 552	Applied Complex Variables	3

At least 12 hours of MATH electives numbered 500-599. The choice of the four MATH electives should be made to support the student's educational goals and career objectives. The courses listed below are available for MATH elective credit. (As MATH 544, MATH 546, and MATH 554 are required of all majors, these are not listed.) Undergraduate students interested in taking 700-level MATH courses as elective credit should consult the Graduate Bulletin.

Course	Title	Credits
<b>Algebra</b>		
MATH 540	Modern Applied Algebra	3
MATH 541	Algebraic Coding Theory	3
MATH 547	Algebraic Structures II	3
MATH 548	Geometry, Algebra, and Algorithms	3
<b>Analysis</b>		
MATH 511	Probability	3
MATH 550	Vector Analysis	3
MATH 551	Introduction to Differential Geometry	3
MATH 552	Applied Complex Variables	3
MATH 555	Analysis II	3
<b>Differential Equations and Modeling</b>		
MATH 520	Ordinary Differential Equations	3
MATH 521	Boundary Value Problems and Partial Differential Equations	3
MATH 522	Wavelets	3
MATH 523	Mathematical Modeling of Population Biology	3
<b>Discrete Mathematics</b>		
MATH 541	Algebraic Coding Theory	3
MATH 570	Discrete Optimization	3

MATH 574	Discrete Mathematics I	3
MATH 575	Discrete Mathematics II	3
MATH 576	Combinatorial Game Theory	3
MATH 587	Introduction to Cryptography	3
<b>Financial Mathematics and Probability</b>		
MATH 511	Probability	3
MATH 514	Financial Mathematics I	3
MATH 515	Financial Mathematics II	3
MATH 525	Mathematical Game Theory	3
<b>Geometry</b>		
MATH 531	Foundations of Geometry	3
MATH 532	Modern Geometry	3
MATH 533	Elementary Geometric Topology	3
MATH 534	Elements of General Topology	3
MATH 551	Introduction to Differential Geometry	3
<b>Mathematic Logic</b>		
MATH 561	Introduction to Mathematical Logic	3
MATH 562	Theory of Computation	3
<b>Number Theory</b>		
MATH 580	Elementary Number Theory	3
MATH 587	Introduction to Cryptography	3
<b>Optimization and Computation</b>		
MATH 524	Nonlinear Optimization	3
MATH 527	Numerical Analysis	3
MATH 570	Discrete Optimization	3
<b>Special Topics</b>		
MATH 599	Topics in Mathematics	1-3

### Guidelines for Selecting 500-level MATH Electives For Students Considering Graduate Studies in Mathematics

Complete at least one of the two-semester sequences in algebra or analysis:

Course	Title	Credits
MATH 546 & 547	Algebraic Structures I and Algebraic Structures II	6
MATH 554 & 555	Analysis I and Analysis II	6

Note: Completing both two-semester sequences provides the strongest foundation for graduate study in mathematics. Students completing this combination of courses are well on their way towards completing the B.S. with Distinction in Mathematics.

### For Students Considering Careers Teaching at the Secondary Level (Grades 9-12)

Complete the following sequence of courses:

Course	Title	Credits
MATH 531 or MATH 532	Foundations of Geometry Modern Geometry	3
MATH 574	Discrete Mathematics I	3
MATH 580	Elementary Number Theory	3
<b>As a cognate:</b>		
EDFI 300	Schools in Communities	3
EDPY 401	Learners and the Diversity of Learning	3

EDSE 500	Equity and Community Engagement	3
EDSE 502	Teachers and Teaching	3
<b>Total Credit Hours</b>		<b>21</b>

Note: With two additional Education courses, students complete a minor in Education. This selection of MATH electives and of the education cognate positions students to complete, after completing a B.S. in Mathematics, a one-year graduate Master of Teaching degree from the College of Education and apply for grades 9-12 mathematics licensure in South Carolina.

### For Students Considering Careers in Actuarial Science

Declare a Risk Management and Insurance Minor (<https://academicbulletins.sc.edu/undergraduate/business/risk-management-insurance-minor/>) and complete their MATH electives from the following:

Course	Title	Credits
MATH 511	Probability	3
MATH 520	Ordinary Differential Equations	3
MATH 574	Discrete Mathematics I	3
MATH 524 or MATH 570	Nonlinear Optimization Discrete Optimization	3
<b>Total Credit Hours</b>		<b>12</b>

Note: Risk Management and Insurance Minor (<https://academicbulletins.sc.edu/undergraduate/business/risk-management-insurance-minor/>) is completed by taking ACCT 225, ECON 221 and ECON 222, and FINA 363, FINA 469, FINA 471, and FINA 475.

To develop a strong basis for success in the initial actuarial examinations (Exam P and Exam FM), and to qualify for the Society of Actuaries' Validation through Educational Experience (VEE) in Applied Statistics, Economics, and Corporate Finance, students should complete the following collection of 30 semester hours in the Department of Statistics and the Darla Moore School of Business. For detailed information about the VEE program, see <http://soa.org>.

Course	Title	Credits
<b>Mathematical Statistics and Statistical Models</b>		
STAT 512	Mathematical Statistics	3
STAT 513	Theory of Statistical Inference	3
ECON 436	Introductory Econometrics	3
<b>Economics and Corporate Finance</b>		
ACCT 225	Introduction to Financial Accounting	3
ECON 221	Principles of Microeconomics	3
ECON 222	Principles of Macroeconomics	3
FINA 363	Introduction to Finance	3
<b>Risk Management and Insurance</b>		
FINA 341	Management of Risk and Insurance	3
<b>Finance and Stochastic Processes</b>		
Select 3-6 hours of the following:		3-6
FINA 469	Investment Analysis and Portfolio Management	
FINA 471	Derivative Securities	
FINA 475	Fixed Income Securities	
STAT 521	Applied Stochastic Processes	
<b>Computing</b>		
Select three hours of the following:		3

CSCE 146	Algorithmic Design II
MGSC 390	Business Information Systems
STAT 540	Computing in Statistics
<b>Total Credit Hours</b>	<b>30-33</b>

### For Students Considering Careers in Applied Mathematics or Mathematical Careers in the Public or Private Sector

Complete MATH 520 and other courses in Differential Equations and Modeling, in Discrete Mathematics, in Financial Mathematics, and in Optimization and Computation, including 9 credit hours from two of the following categories:

Course	Title	Credits
<b>Differential Equations and Modeling</b>		
MATH 521	Boundary Value Problems and Partial Differential Equations	3
MATH 522	Wavelets	3
MATH 523	Mathematical Modeling of Population Biology	3
<b>Discrete Mathematics</b>		
MATH 541	Algebraic Coding Theory	3
MATH 548	Geometry, Algebra, and Algorithms	3
MATH 570	Discrete Optimization	3
MATH 574	Discrete Mathematics I	3
MATH 575	Discrete Mathematics II	3
MATH 576	Combinatorial Game Theory	3
MATH 587	Introduction to Cryptography	3
<b>Financial Mathematics and Probability</b>		
MATH 511	Probability	3
MATH 514	Financial Mathematics I	3
MATH 515	Financial Mathematics II	3
<b>Optimization and Computation</b>		
MATH 524	Nonlinear Optimization	3
MATH 527	Numerical Analysis	3
MATH 570	Discrete Optimization	3
<b>Analysis</b>		
MATH 550	Vector Analysis	3
MATH 552	Applied Complex Variables	3
MATH 555	Analysis II	3

## B.S. with Distinction in Mathematics (39 hours)

### Prerequisite

A minimum GPA of 3.60 in upper division (500 and above) major courses, and 3.30 cumulative when the student applies to enter the B.S. with Distinction in Mathematics.

### Requirements

The student should apply to enter the B.S. with Distinction in Mathematics track and choose the members of the thesis committee as early as possible, but in all cases at least one year before completion of the degree. The committee will consist of a thesis advisor, who must be a tenure-track faculty member in Mathematics, and one or two other tenure-track or research faculty members in Mathematics or any other department, as approved by the Undergraduate Program Committee. The senior thesis consists of either significant original work or a synthesis of known material beyond the scope of ordinary undergraduate coursework. The student may use their senior thesis to simultaneously fulfill other

requirements as well (e.g., Magellan Scholarship, Honors College Thesis, etc.), at the discretion of the thesis advisor.

By the end of the semester in which the student is admitted into the B.S. with Distinction in Mathematics track, a brief research plan must be agreed upon by the thesis committee and the student, and filed in the Department of Mathematics and College of Arts and Sciences. Before submitting and defending the thesis, the student must have completed three credit hours of MATH 499 under the supervision of the thesis advisor, and at least 12 hours of upper-level (500-599) MATH credit approved by the Undergraduate Director beyond the 24 credit hours of 500-level MATH courses required for the B.S. in Mathematics.

By the end of the student's last semester, the student must present and defend the senior thesis before the thesis committee. The defense must be announced at least one week in advance and be open to the general public. A certificate attesting to a successful defense, signed by the committee, must be placed on file with both the Department of Mathematics and the College of Arts and Sciences. In addition, prior to graduation the student must have either (a) presented the research at a meeting of a professional society, at Discovery Day at USC, or at a comparable venue; or (b) submitted the work for publication in an undergraduate or professional journal.

## Major Map

A major map is a layout of required courses in a given program of study, including critical courses and suggested course sequences to ensure a clear path to graduation.

Major maps are only a suggested or recommended sequence of courses required in a program of study. Please contact your academic advisor for assistance in the application of specific coursework to a program of study and course selection and planning for upcoming semesters.

### Mathematics, B.S.